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(54) FLUORO RUBBER COMPOSITION AND METHOD OF MANUFACTURING THE SAME

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a fluoro rubber composition capable of giving a cured article suitable for automatic loading represented by mechanization or robotization due to its excellent surface lubrication, excellent in conventional properties such as cold resistance, chemical resistance, oil resistance and the like and excellent in mechanical properties of rubber.

SOLUTION: This fluoro rubber composition comprises (A) 100 pts.wt. of a liquid perfluoro compound containing at least two alkenyl groups in the molecule and a divalent perfluoroalkylene or a divalent perfluoro ether structure in the main chain, (B) 1-100 pts.wt. of a reinforcing filler, (C) a precured base obtained by precuring a compound (C) having at least two hydrosilyl groups in the molecule capable of carrying out an addition reaction and the component (A) in a molar ratio of the hydrosilyl group of the component (C) to the alkenyl group of the component (A)=0.1-0.99 in the presence of an addition reaction catalyst, (D) 1-30 pts.wt. based on the 100 pts.wt. of the component (A), of a fluorine-containing oil insoluble in the polymer of the component (A) and (E) an effective amount of a crosslinking agent to the component (A).

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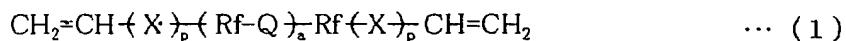
CLAIMS

[Claim(s)]

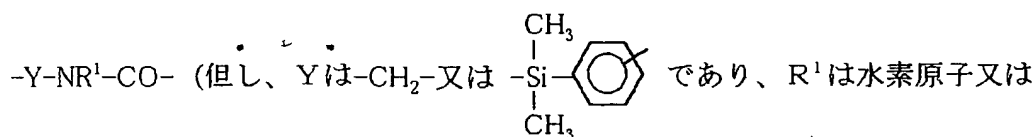
[Claim 1] (A) The liquefied perfluoro compound which has at least two alkenyl radicals in a molecule, and has divalent perfluoro alkylene or divalent perfluoro polyether structure in a principal chain The 100 weight (sections B) reinforcement nature filler The compound which contains at least two hydrosilyl radicals in the 1 - 100 weight (section C) molecule and in which an addition reaction is possible (C) -- the amount used as alkenyl radical (mole ratio) = 0.1-0.99 of the hydrosilyl radical / (A) component of a component is not dissolved in the polymer of the precure base (D) which comes to carry out precure under existence of an addition reaction catalyst, and the (A) component -- fluorine content oil the (above-mentioned A) component 100 weight section -- receiving -- cross linking agent of the 1 - 30 weight section (E) above-mentioned (A) component Fluororubber constituent characterized by containing a bridge formation effective dose.

[Claim 2] The constituent according to claim 1 which is a compound in which the perfluoro compound in the (aforementioned A) component is shown by the following general formula (1).

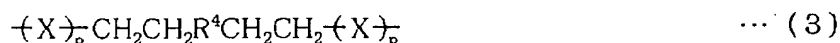
[Formula 1]



[式中、Xは独立に $-\text{CH}_2-$ 、 $-\text{CH}_2\text{O}-$ 、 $-\text{CH}_2\text{OCH}_2-$ 、 $-\text{Y}-\text{NR}^1\text{SO}_2-$ 又は



置換又は非置換の1価炭化水素基)を示し、Rfは2価パーフルオロアルキレン基又は2価パーフルオロポリエーテル基を示し、pは独立に0又は1である。Qは下記一般式(2)、(3)又は(4)



[式中、X、p、 R^1 は上記と同様の意味を示し、 R^3 は置換又は非置換の2価炭化水素基であり、 R^4 は結合途中に酸素原子、窒素原子、ケイ素原子及び硫黄原子の1種又は2種以上を介在させてもよい置換又は非置換の2価炭化水素基あるいは下記一般式(5)又は(6)



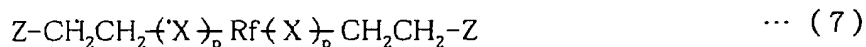
(R^5 は置換又は非置換の1価炭化水素基、 R^6 は炭素原子、酸素原子、窒素原子、ケイ素原子及び硫黄原子の1種又は2種以上を主鎖構造中に含む基)

で示される基である。]

で示される基を意味し、aは0以上の整数である。]

[Claim 3] The constituent according to claim 1 or 2 which is a compound in which the compound which has at least two hydrosilyl radicals in the molecule of the aforementioned (C) component, and in which an alkenyl radical and an addition reaction are possible is shown by the following general formula (7) or (8).

[Formula 2]



[式中、X, p, R f は上記と同様の意味を示す。Z は下記一般式 (9)]



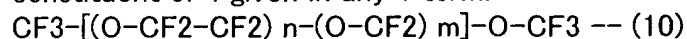
(但し、R² は置換又は非置換の 1 価炭化水素基、b は式 (7) の化合物の場合は

1, 2 又は 3、式 (8) の化合物の場合は 2 又は 3 である。)

で示される基を示す。]

[Claim 4] Claim 1 which is the fumed silica processed by the finishing agent to which the reinforcement nature filler of the aforementioned (B) component contains silicon in fumed silica or a molecule thru/or the constituent of 3 given in any 1 term.

[Claim 5] Claim 1 which the viscosity of the fluorine content oil which is not dissolved in the polymer of the (A) component of the aforementioned (D) component is 50-500,000cSt, and is that the molecular structure is indicated to be by the following general formula (10) thru/or the constituent of 4 given in any 1 term.



(However, n and m are integers.)

[Claim 6] Furthermore, claim 1 which blended the heat-resistant improver which used together one sort chosen from carbon black, a metallic oxide, and a metal hydroxide, or two sorts or more thru/or the constituent of five given in any 1 term.

[Claim 7] The manufacture approach of claim 1 characterized by carrying out addition mixing of (D) and the (E) component after mixing and making the - (C) component (above-mentioned [A]) react thru/or the fluororubber constituent of 5 given in any 1 term.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] Without carrying out bleed out during preservation, this invention serves as a hardened material which carried out bleed out after bridge formation, and was excellent in surface lubricity, and is excellent in molding workability, and relates to the fluororubber constituent with which thermal resistance, solvent resistance, chemical resistance, low temperature-dependency-characteristics nature, and a mechanical strength give a good hardened material, and its manufacture approach.

[0002]

[Description of the Prior Art] Since the conventional vinylidene fluoride system fluororubber is the elastomer excellent in thermal resistance, chemical resistance, a mechanical strength, etc., it is industrially used in the large field focusing on an automobile and machine industry.

[0003] However, the chemical resistance is insufficient, and it swells easily in polar solvents, such as a ketone system, a lower alcohol system, a carbonyl system, and an organic-acid system, and has the fault that will deteriorate to the chemical containing an amine and rubber reinforcement and elongation will fall extremely.

[0004] Then, in order to improve those faults, the fluorine-containing hardenability constituent which uses a perfluoro compound and a fluorine-containing ORGANO hydrogen polysiloxane as a principal component is proposed.

[0005] However, since these constituents turn into a liquefied constituent from the low polymerization degree of a perfluoro compound being liquefied, although they fit a FIPG method of construction and LIMS molding, they will be inferior in workability in compression molding conventionally used by rubber molding.

[0006] Especially the production stabilized if the conventional two-sheet metal mold for rubber could not be used by frequent occurrence of the defect by molding workability and the contamination of Ayr etc. in many cases and LIMS metal mold of dedication was not newly created is difficult.

[0007] However, generally compared with the conventional two-sheet metal mold for rubber, it is expensive, and time is taken in the installation to a LIMS briquetting machine, or LIMS metal mold has troubles, like adjustment of the machine after metal mold installation takes time amount, and is unsuitable for limited production with a wide variety.

[0008] The approach of manufacturing with the fluorine-containing hardenability constituent used as a principal component is desired [polysiloxane / the perfluoro compound and / fluorine-containing ORGANO hydronalium] from such a background in the type rubber constituent (it is hereafter called a millable type constituent) in which the roll activity for rubber is possible and molding by the rubber metal mold for compression molding is possible.

[0009] On the other hand, it became general to assemble in mass production method in recent years, to mechanize a process and to robotize, and being incorporated by the machine has increased rather than human being also carries a rubber workpiece. In this case, the adhesiveness on the front face of rubber checks mechanization in many cases, and clearance and lubricative grant of surface adhesiveness are called for.

[0010] Although it is possible to remove surface adhesiveness easily and to raise surface slipping nature by applying a hexamethylenediamine etc. to a cast front face since a vinylidene fluoride system fluororubber has reactivity to the compound of an amine system, the above-mentioned fluorine-containing hardenability constituent has the fault that surface treatment is difficult, for the chemical stability.

[0011] When it was made in view of the above-mentioned situation and thermal resistance, solvent resistance, chemical resistance, low temperature-dependency-characteristics nature, and a mechanical strength give a good hardened material, the roll activity for rubber is possible, molding by the rubber metal mold for compression molding is possible, and this invention aims at offering the fluororubber constituent which gives the outstanding hardened material of surface lubricity, and its manufacture approach.

[0012]

[The means for solving a technical problem and the gestalt of implementation of invention] The liquefied perfluoro compound shown in (A) following as a result of inquiring wholeheartedly, in order that this invention person may solve the above-mentioned problem, (B) A reinforcement nature filler, the preure base which comes to carry out preure of the compound which contains at least two hydrosilyl radicals in the (C) molecule, and in which an addition reaction is possible under existence of an addition reaction catalyst, (D) the fluorine content oil which is not dissolved in the polymer of the (A) component and the fluororubber constituent which comes to contain the cross linking agent of the (E) above-mentioned (A) component When thermal resistance, solvent resistance, chemical resistance, low temperature-dependency-characteristics nature, and a mechanical strength give a good hardened material, the roll activity for rubber is possible. Molding by the rubber metal mold for compression molding was possible, and it found out becoming the hardened material which carried out bleed out after bridge formation, and was excellent in surface lubricity, without carrying out bleed out during preservation.

[0013] That is, by adding the fluorine content oil shown in a fluorine-containing hardenability constituent below, when this fluorine content oil carries out bleed out to a hardened material front face after hardening, the adhesiveness on the front face of rubber is removed, and it comes to make a header and this invention for becoming the hardened material with which lubricity was given.

[0014] Therefore, the liquefied perfluoro compound which this invention has at least two alkenyl radicals in the (A) molecule, and has divalent perfluoro alkylene or divalent perfluoro polyether structure in a principal chain The 100 weight (section B) reinforcement nature filler The compound which contains at least two hydrosilyl radicals in the 1 - 100 weight (section C) molecule and in which an addition reaction is possible (C) — the amount used as alkenyl radical (mole ratio) = 0.1-0.99 of the hydrosilyl radical / (A) component of a component is not dissolved in the polymer of the preure base (D) which comes to carry out preure under existence of an addition reaction catalyst, and the (A) component — fluorine content oil As opposed to the component 100 weight section (above-mentioned [A]) The cross linking agent of the 1 - 30 weight section (E) above-mentioned (A) component After mixing and making the fluororubber constituent characterized by containing a bridge formation effective dose, and the - (C) component (above-mentioned [A]) react, the manufacture approach of the fluororubber constituent obtained at the process which carries out addition mixing of (D) and the (E) component is offered.

[0015] Hereafter, lessons is taken from this invention and it explains in more detail. The (A) component of the fluororubber constituent of this invention is a liquefied perfluoro compound which has at least two alkenyl radicals in a molecule, and has divalent perfluoro alkylene or divalent perfluoro polyether structure in a principal chain.

[0016] Here the perfluoro compound of the above-mentioned (A) component Compounding to resin or an amount polymer of macromolecules like rubber technically with a difficult compound Have at least two alkenyl radicals in a molecule, and it has divalent perfluoro alkylene or divalent perfluoro polyether structure in a principal chain. Preferably, the viscosity in 25 degrees C is the straight chain-like perfluoro compound which is 25-1,000,000cSt, and what is shown, for example

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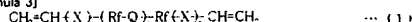
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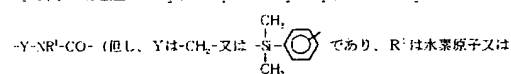
by the following general formula (1) is mentioned as this perfluoro compound.

[0017]

[Formula 3]



[式中、Xは独立に-CH₂-, -CH₂O-, -CH₂OC(CH₃)₂-, -Y-NR¹SO₂-又は



置換又は非置換の1価炭化水素基)を示し、Rは2価パーフルオロアルキレン

基又は2価パーフルオロポリエーテル基を示し、pは独立に0又は1である。Q

は下記一般式(2)、(3)又は(4)



[式中、X、p、R¹は上記と同様の意味を示し、R¹は置換又は非置換の2価炭化水素基であり、R¹は結合途中に酸素原子、窒素原子、ケイ素原子及び硫黄原子の1種又は2種以上を介在させてもよい置換又は非置換の2価炭化水素基あるいは下記一般式(5)又は(6)



(R²は置換又は非置換の1価炭化水素基、R¹は炭素原子、酸素原子、窒素原子、ケイ素原子及び硫黄原子の1種又は2種以上を主鎖構造中に含む基)

で示される基である。]

で示される基を意味し、nは0以上の整数である。]

[0018] here, it is a divalent perfluoro alkylene group or a divalent perfluoro polyether radical, as for Rf, what is shown especially as a divalent perfluoro alkylene group by -CmF2m- (m=1-10 (however,) — it is 2-6 preferably.) is desirable, and what is shown by the following formula as a divalent perfluoro polyether radical is desirable.

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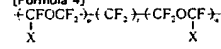
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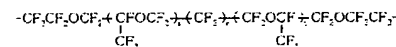
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[0019]

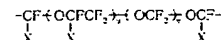
[Formula 4]



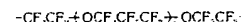
(XはF又はCF₃基、p、q、rはそれぞれp≧1、q≧1、2≦p+q≦200、特に2≦p+q≦110、0≦r≦6の整数)



(r、s、tはそれぞれ0≦r≦5、s≧0、t≧0、0≦s+t≦200、特に2≦s+t≦110の整数)

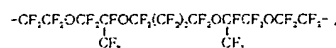
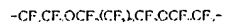


(XはF又はCF₃基、u、vはそれぞれ1≦u≦100、1≦v≦50の整数)



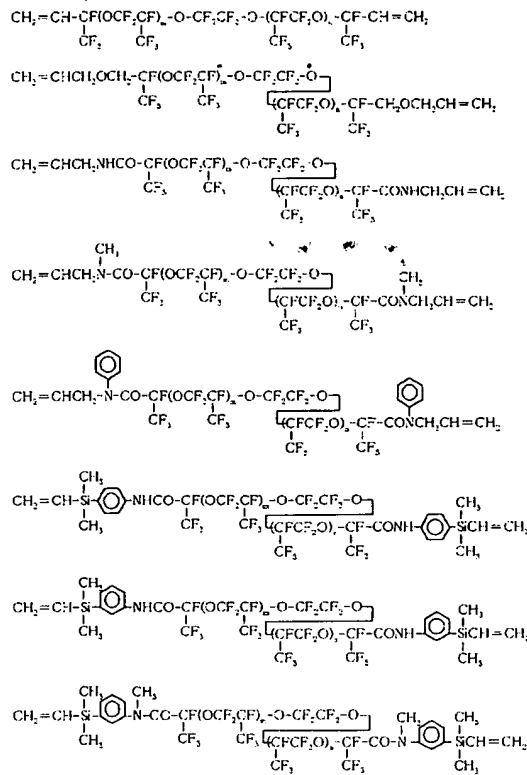
(wは1≦w≦100の整数)

R fとして具体的には、下記のものが例示される、



[0020] Next, Q is a radical shown by the following general formula (2), (3), or (4). [Formula 5]

[Formula 11]



(However, among a formula, m and n are zero or more integers, and are a value which sets viscosity in 25 degrees C to 25-1,000,000cSt preferably.)
 [0038] As for the straight chain-like perfluoro compound of the above-mentioned (A) component, it is desirable that the viscosity in 25 degrees C is in the range of 25-1,000,000cSt, and it is especially desirable that it is 100-60,000cSt. It becomes difficult for viscosity to form the rubber hardened material which has the property satisfied at this time out of range, or there is a possibility of producing the inconvenience of workability falling.
 [0039] The (B) component of the fluororubber constituent of this invention is a reinforcement

nature filler. Although roll workability, a mechanical strength, thermal stability, weatherability, chemical resistance, fire retardancy, etc. are raised or it is added for the object, such as lowering reduction of the heat shrink at the time of hardening, decline in the coefficient of thermal expansion of the elastic body hardened and obtained, and gas permeability, this reinforcement nature filler is blended in order to mainly make it the constituent of a millable type, and to raise roll workability and a mechanical strength.
 [0040] As a reinforcement nature filler, metal carbonates, such as metallic oxides, such as fumed silica, colloidal silica, diatomaceous earth, quartz powder, a glass fiber, carbon, and ferrous oxide, titanium oxide, cerium oxide, a calcium carbonate, and a magnesium carbonate, etc. can be mentioned, and these may be processed by various finishing agents, for example. In these, the point of a mechanical strength to fumed silica is desirable, and in order to raise especially dispersibility, what was processed by the finishing agent which contains silicon in molecules, such as a silane system, is desirable.
 [0041] the loadings of a reinforcement nature filler are the 1-100 section to the (A) component 100 section (the weight section and the following -- the same). In the less than 1 section, while the reinforcement nature of a filler falls, roll workability falls, if it exceeds the 100 sections, the flexibility of rubber will be lost, or the inconvenience of stopping coiling around a roll etc. arises.
 [0042] In addition, a finishing agent may be added as an arbitration component at the time of reinforcement nature filler combination of the (B) component. A finishing agent is an arbitration component for raising the wettability between a reinforcement nature filler combination and distribution easy, and raising the mechanical strength of a constituent, and what contains the phloralkyl radical or fluoropoly alkyl ether radical which has the compatibility of the silanol group which has the compatibility on the front face of a filler, and the perfluoro principal chain of a polymer as this finishing agent in [at least one] a molecule is desirable.
 [0043] Next, as a compound which contains at least two hydrosilyl radicals in the molecule of the (C) component and in which an alkenyl radical and an addition reaction is possible, although a hydrosilyl radical is contained in what contains a hydrosilyl radical in an organic compound, and an organic silicon compound, when dispersibility and thermal resistance are taken into consideration, the compound of the formula (7) shown below or a formula (8) is desirable.
 [0044]
 [Formula 12]

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(式中、X、p、R f は上記と同様の意味を示す、Z は下記一般式 (9))

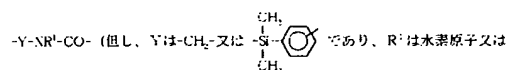


(但し、R²は置換又は非置換の1価炭化水素基、nは式(7)の化合物の場合は

1、2又は3、式(8)の化合物の場合は2又は3である。)

で示される基を示す。)

ここで、Xは独立に-CH₂、-CH₂O、-CH₂OCH₂、-Y-NR²SO₂、又は



置換又は非置換の1価炭化水素基)を示し、R fは2価パーフルオロアルキレン

基又は2価パーフルオロポリエーテル基を示し、pは独立に0又は1である。

[0045] Although it is as having mentioned above about Rf, X, and p, you may differ, even if Rf, X

and p in a formula (7) and (8), and Rf, X and p in a formula (1) are mutually the same.

[0046] Moreover, Z is a radical shown by the following general formula (9).



[0047] R2 is a permutation or an unsubstituted monovalent hydrocarbon radical here. As the permutation or the unsubstituted monovalent hydrocarbon radical of R2 The thing of carbon numbers 1-8 is desirable. As these radicals specifically A methyl group, an ethyl group, a propyl group, an isopropyl group, butyl, an isobutyl radical, tert-butyl, a pentyl radical, a neopentyl radical, a hexyl group, a heptyl radical, Alkyl groups, such as an octyl radical, a cyclopentyl group, a cyclohexyl radical, Aryl groups, such as cycloalkyl radicals, such as a cycloheptyl radical, a phenyl group, a tolyl group, and a xyl group. A part or all of a hydrogen atom of aralkyl radicals, such as benzyl and a phenylethyl radical, or these radicals A fluorine. The chloro methyl group permuted by halogen atoms, such as chlorine and a bromine, etc., a BUROMO ethyl group, a chloropropyl radical, a trifluoro propyl group, 3, 3, 4, 4, 5, 5, 6 and 6, a 6-nona fluoro hexyl group, etc. can be mentioned.

[0048] Moreover, in the case of the compound of a formula (7), in the case of the compound of

1, 2 or 3, and a formula (8), b is 2 or 3.
 [0049] (C) The rate of the (A) component and the (C) component is [the alkenyl radical weight in the hydrosilyl radical weight / (A) component in the (C) component of the loadings of a component] 0.1 to 0.99, and the range preferably set to 0.3-0.8 in a mole ratio. It is extent which a constituent thickens somewhat as this ratio is less than 0.1, if it becomes difficult liquid rubber to work by ***ing with 2 rolls for rubber in order that a fluidity may remain and it exceeds 0.99, it will become the hardened material of rubber, and addition of a filler becomes difficult or the nonconformity of not coiling around a roll arises.

[0050] In this invention, precure of the above (A), (B), and the (C) component is carried out under existence of an addition reaction catalyst, and the precure base is obtained and let this be a combination component.

[0051] Here, as an addition reaction catalyst, a platinum metal compound is desirable. Generally a platinum metal compound is a compound of noble metals, and the platinum compound which is comparatively easy to come to hand is well used from it being an expensive rank.

[0052] As a platinum compound, although a complex, a complex with alcohol or a vinyl siloxane, platinum/silica, an alumina, or carbon of chloroplatinic acid or chloroplatinic acid, and olefins, such as ethylene, etc. can be illustrated, for example, it is not limited to these. a platinum compound -- except -- a platinum metal -- a compound -- ***** -- a rhodium -- a ruthenium -- iridium -- palladium -- a system -- a compound -- getting to know -- having -- **** -- for example, -- RhCl (PPh3) -- three -- RhCl -- (CO) -- (PPh3) -- two -- RhCl (C2H4) -- two -- Ru -- three -- (CO) -- 12 -- IrCl -- (CO) -- (PPh3) -- two -- Pd (PPh3) -- four -- a grade -- it can illustrate.

[0053] Although especially the amount of these catalysts used can obtain the cure rate which it is not restricted and is considered as a request in the amount of catalysts, in order to obtain an economical standpoint or a good hardened material, it is good to make more preferably 0.1-1,000 ppm (platinum metal conversion) into the range of 0.1-500 ppm (same as the above) extent to the whole quantity of (A) and the (C) component.

[0054] Although the conditions of the addition reaction for the above-mentioned precure can be selected suitably and a reaction may be performed at a room temperature, for speeding up a reaction, it can heat at 100-200 degrees C, and can carry out for 10 seconds to 60 minutes.

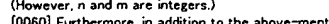
[0055] (D) The fluorine content oil of a component is the important additive of this invention, and the stability of a constituent and lubricity change with these classes and additions a lot.

[0056] Don't dissolve this fluorine content oil in the liquefied polymer of the (A) component. (A) Since a rubber degree of hardness falls and surface adhesiveness increases in order to distribute to stability that it is what is dissolved in the polymer of a component in a constituent, not to consider as bleed out and to act as a plasticizer, stop acting as a surface lubricity grant agent which is the original object.

[0057] Moreover, it is also required in a molecule to have a fluorine content radical. Since there is no compatibility with a polymer when there is no fluorine content radical, when a constituent scours, moving to a front face and carrying out bleed out is lost.

[0058] Therefore, if the requirement of the fluorine content oil of this invention is not what combines the polymer of the (A) component, a certain amount of compatibility, and non-phase solubility, it will not become.

[0059] As the concrete desirable chemical structure, what is expressed with the following general formula (10) is mentioned.



(However, n and m are integers.)

[0060] Furthermore, in addition to the above-mentioned conditions, viscosity is also important for the fluorine content oil of this invention. When the viscosity of addition oil is low, bleed out will be carried out also in the state of the constituent before hardening, the shelf life of a constituent will pose a problem, and, as for the case of hyperviscosity, the passing speed to the front face of oil will become slow. In this invention, it is desirable to carry out bleed out by the post cure after heating at the time of press molding and molding, and, as for the viscosity range, it is still more preferably desirable that it is 100-50,000cSt 50 to 500,000 cSt.

[0061] Moreover, the effectiveness of the addition of surface lubrication decreases that it is the 1-30 section and is the less than 1 section to the polymer of the (A) component, and if it exceeds the 30 sections, a mechanical strength will fall. Furthermore, it is the three to 20 section preferably.

[0062] The (E) component of this invention is a cross linking agent, and this carries out full hardening of this invention constituent thru/or the (A) component. As a cross linking agent, the cross linking agent which contains a hydrosilyl (E-1) radical in a molecule and in which an addition reaction is possible, or a peroxide (E-2) cross linking agent is used.

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rubber sheet which has a surface characteristic with small coefficient of friction as compared with oil un-adding [of the example 4 of a comparison] was obtained. There was little oil bleeding at this time as compared with an example 3. The addition and assessment result of oil are shown in a table 2.

[0093] Although the oil 3 and 4 which has the perphloro polyether structure of resemblance in the example by the same addition number of copies as the [examples 1 and 2 of comparison] example 3 was added, rubber physical properties and a surface characteristic were evaluated and this addition effectiveness was checked like the example 3, since this oil was melted in a polymer, bleeding was not carried out to a front face and improvements of a surface characteristic were few. The addition and assessment result of oil are shown in a table 3.

[0094] Although there was no dissolution to a polymer since polymer structure was completely different silicone system oil when rubber physical properties and a surface characteristic were evaluated and the addition effectiveness of oil 5 was checked like the example 3 by the same addition number of copies as the [example 3 of comparison] example 3, since there was also no compatibility with a polymer, oil could not be moved to a front face, and bleeding was not generated. The addition and assessment result of oil are shown in a table 3.

[0095] When the assessment same about the constituent before adding [example 4 of comparison] oil as an example was performed, the constituent before adding oil had large coefficient of friction, and was what has some surface adhesiveness. This assessment result is shown in a table 3.

[0096]

[A table 2]

	例3例1	例3例2	例3例3	例3例4	例3例5
(例3例1)					
オイル性	オイル1	オイル4	オイル1	オイル1	オイル2
重量 (g)	600	640	600	620	1500
オイルとの混合	分離	分離	分離	分離	分離
オイル添加量 (100%に相当する割合)	3	5	6	12	8
(ゴム物性)					
硬度 (JIS A)	71	70	66	65	70
引っ張り強度 (MPa)	12.1	11.7	12.0	11.1	11.0
伸び (%)	300	320	350	350	320
引張強度 (kN/a)	21	22	21	21	23
(表面特性)					
摩擦係数	0.8	0.2	0.2	0.1	0.0

[0097]

[A table 3]

	比較例1	比較例2	比較例3	比較例4
(例3例1)				
オイル性	オイル3	オイル4	オイル5	なし
重量 (g)	470	180	1000	-
オイルとの混合	溶解	溶解	分離	-
オイル添加量 (100%に相当する割合)	8	8	8	-
(ゴム物性)				
硬度 (JIS A)	59	64	58	71
引っ張り強度 (MPa)	12.4	12.0	10.3	11.2
伸び (%)	340	300	340	300
引張強度 (kN/a)	20	21	20	23
(表面特性)				
摩擦係数	1.1	1.2	1.1	1.4

[Translation done.]